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PATENT SPECIFICATION

(11) 1 466 853

(21) Application No. 24272/73 (22) Filed 22 May 1973
(23) Complete Specification filed 17 May 1974
(44) Complete Specification published 9 March 1977
(51) INT CL² B01D 11/02
(52) Index at acceptance B1Q 1
C5C 6A3 6A4 6C3

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SCIENCE REFERENCE LIBRARY

(54) EXTRACTION

(71) We, SIMON - ROSEDOWNS LIMITED, (formerly Rose, Downs and Thompson Limited), a British Company, of Old Foundry Cannon Street, Hull, HU2 0AD, Yorkshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to extraction and is particularly concerned with the solvent extraction of a constituent from natural products of animal or vegetable origin, in powder form. The invention is primarily directed towards extracting oil from yeast powder.

When yeast cells are grown on a substrate of mineral oil, petroleum gas or a waste carbohydrate, the product yeast is a mass of unicellular organisms. The yeast when harvested, and after removal of any adherent substrate, is obtained as a fine powder. For extraction of the contained oil, the walls of the yeast cells must be first ruptured, so that, when a solvent for the oil is percolated through the mass of yeast cells, the oil is contacted by the solvent.

However, we have found that yeast powder is so finely divided that proper percolation of a solvent through it is impossible in practice. In an attempt simultaneously to cause cell breakdown and to bring the powder into a form suitable for percolation by a solvent, we have tried to form the powder, in either a cooked or an uncooked state, into flakes by passing the powder through flaking rolls. This expedient however was also unsuccessful, because the yeast powder is so finely divided that either it falls freely through the roll gap of the flaking rolls without compression or, if the feed rate is increased sufficiently, it completely fills the roll gap and the flaking rolls stall.

We have found that the twin aims of rupturing the yeast cell walls and of presenting the yeast powder in a form suitable for subsequent percolation with a solvent are achieved, when the powder is first formed into pellets which are then flaked.

Thus, the present inventi n resides broadly in a method of extracting a constituent fr m natural products of animal or vegetable origin, in powder form, the method comprising forming pellets of the powder, flaking the pellets and subjecting the flakes to a solvent extraction process, using a solvent for the required constituent.

As applied to yeast powder, the invention provides a method of extracting oil from yeast powder, the method comprising forming pellets of the yeast powder, flaking the pellets, and subjecting the flakes to a solvent extraction process, by percolating a solvent for the contained oil through the flakes.

Preferably, the yeast powder, prior to pelletising, is cooked by the application of heat, cooking may be accompanied by the addition of steam, for example in an amount sufficient to bring the moisture content of the powder to about 20% by weight prior to pelletising. We have found that a pellet size of approximately $\frac{1}{8}$ inch is suitable.

Before extracting the flakes, it is preferred to harden them, by drying the flakes to a moisture content of between 5 and 10% by weight.

The invention will be more readily understood by the following description of an example for extracting oil from yeast powder.

The harvested powder was heated to a temperature between 70 and 80°C in a steam jacketed cooker. At the same time, live steam was allowed into the cooker until the yeast picked up sufficient moisture to have a moisture content of about 20%. The wet powder from the cooker was then fed to a pelleting machine and converted into pellets of approximately $\frac{1}{8}$ inch diameter.

The pellets were fed to a pair of flaking rolls by a vibrating feeder, the gap setting of the rolls being chosen to be between 3 and 8 thousandths of an inch. The resulting flakes were well formed, but, being wet, had low mechanical strength. Before further treatment, they were therefore dried in an oven f r 40 minutes to reduce the moisture content to between 5 and 10% by weight. The resulting flakes were screened t remove the small amount of fines present, the removed fines being recycled to the pelletiser.

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Finally, the flakes were solvent extracted with n-hexane in a continuous solvent extraction device such as that sold under the Registered Trade Mark "ROTOCEL".

The following Table I shows the importance of rupturing the yeast cells by flaking. In each of the samples of the Table, the yeast after treatment as stated was extracted for seven hours on a standard Soxhlet extractor. The figures given in the final column represent the oil extracted as a percentage of the original sample less water; the full oil content of the yeast is not easy to determine but is believed to be not in excess of 20% of the water free yeast powder.

TABLE I

Sample	% Water	% Oil
Original Powder	9.0	8.6
Powder cooked without moisture addition	—	7.7
Powder cooked with moisture addition	21.4	9.9
Powder cooked with moisture addition and flaked	18.9	13.3
Powder cooked with moisture addition and pelleted	20.6	14.7
Powder cooked with moisture addition, pelleted and flaked	19.4	18.8

It can be seen from this table that even prolonged extraction fails to extract much of the oil from the original powder and vigorous mechanical working is required to give full oil extraction.

While the results in Table I indicate the oil extraction that is obtainable, they do not show whether or not oil extraction is possible in a commercial extraction plant. Table II indicates that that extraction is possible. In Table II mesh sizes are British Standard Sieve mesh sizes.

TABLE II

TABLE II

Sample No.	Sample	% Water	Percolation Rate (lbs/hour/sq.ft.)	Solvent Ratio (by weight)	Time Mins.	Residual Oil %
1.	Powder cooked with added moisture, pelleted and flaked	10.9	853	2.5:1	90	0.6
2.	Powder cooked with added moisture, pelleted and flaked then dried	2.1	760	2.5:1	90	1.1
3.	Powder cooked with added moisture, pelleted, flaked and dried, sieved to remove material through 100 mesh (10.8%)	2.1	3,600	1.5:1	60	0.9
4.	Powder cooked with added moisture, pelleted, flaked and dried. Sieve test showed 2.8% through 100 mesh which was not removed	7.3	6,300	1.5:1	60	1.0

It will be seen that in Sample 1, in which the yeast powder was cooked, pelleted and flaked, good oil recovery was achieved, although a relatively high solvent ratio and a long extraction time was required because the flakes were mechanically weak, as shown by the low percolation rate. Sample 2 demonstrates that no improvement is obtained by strong drying. In Sample 3, 10.8% of fines were removed from the flakes before extraction, resulting in a much improved percolation rate and thus the ability to use a lower solvent ratio and a shorter extraction time. Sample 4 was powder which was cooked with a 20% water addition, pelleted, flaked and then dried to 7.3% moisture (as compared with the 2.1% of Sample 3); the flakes produced were strong and contained only a small quantity of fines and consequently had a very good percolation rate. The figure for residual oil in Sample 4 is closely similar to that of Sample 3, although the drying time was much shorter. The flakes were of a type that could be processed easily in a commercial extractor such as a "Rotocel".

WHAT WE CLAIM IS:—

1. A method of extracting a constituent from natural products of animal or vegetable origin, in powder form, the method comprising forming pellets of the powder, flaking the pellets, and subjecting the flakes to a solvent extraction process, using a solvent for the constituent to be extracted.

2. A method of extracting oil from yeast powder, comprising forming pellets of the

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yeast powder, flaking the pellets, and subjecting the flakes to a solvent extraction process, by percolating a solvent for the contained oil through the flakes.

3. An extraction method according to claim 2, in which the yeast powder, prior to pelletising, is cooked by the application of heat.

4. An extraction method according to claim 3, in which cooking is accompanied by the addition of steam to the powder in order to increase the moisture content of the powder.

5. An extraction method according to claim 4, in which the powder has a moisture content of about 20% by weight prior to pelletising.

6. An extraction method according to claim 4 or claim 5, in which the flakes are dried, prior to the solvent extraction process, to a moisture content of between 5 and 10% by weight.

7. An extraction process according to any one of claims 2 to 6, in which the yeast powder is formed into pellets having a diameter of approximately $\frac{1}{8}$".

8. An extraction process according to any one of the preceding claims, in which the pellets are flaked between flaking rolls, having a gap size of between 3 and 8 thousandths of an inch.

9. An extraction process according to any one of the claims 2 to 8, in which the solvent is n-hexane.

10. An extraction process according to any one of the preceding claims, substantially as herein specifically described.

11. A constituent, or oil, extracted by the method according to any one of the preceding claims.

12. A solid residue resulting from treatment for extraction of a constituent, or oil, of a natural product by the method according to any one of the preceding claims.

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For the Applicants.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1977.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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